

Estimating Occupational Disease Hazards Through Medical Care Plans

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ASSESSMENT of the effects of the occupational environment on illness has become increasingly difficult as the more obvious harmful conditions have come under control. It seems certain, however, that important causal relationships between the occupational environment and illness are as yet unrecognized. As an initial step in discovering these relationships, epidemiologic data are needed on the frequency of disease in a variety of occupational groups.

One potential source for determining the frequency of illness in working populations is records generated by comprehensive medical care plans. These plans have been extended in recent years and now cover populations in a wide variety of working environments. They provide an opportunity for continuous surveillance of defined populations and provide morbidity data based on clinical examinations and under conditions where economic barriers should not be a deterrent to the establishment of diagnoses.

Despite these advantages, medical care statistics are not entirely suitable for epidemiologic investigations. Regardless of the availability and comprehensiveness of medical services, experience has shown that some eligible persons in need of medical care do not use such services. Thus, medical care statistics probably do not represent a complete inventory of dis-

eases and conditions as they arise in the population. Moreover, comparisons among occupational groups may be affected by administrative differences between plans or variations in benefits accorded groups of workers under a single plan.

Only by studying and comparing morbidity rates arising from medical care data can the importance of the defects of these data for use in epidemiologic investigations be estimated. To date very little has been published regarding the illness experience of populations covered by comprehensive medical care programs. In 1952 Weissman (1) reported diagnostic data from the Permanente Health Plan, and in 1960 Densen and co-workers (2) reported similar data from the Health Insurance Plan of Greater New York (HIP). Perhaps an important reason for the lack of material is the fact that, in most programs, records have been designed and are maintained primarily for administrative purposes and do not readily lend themselves to the measurement of morbidity.

The Study Group

This report covers the illness experience of a group of longshoremen in Stockton, Calif., as reflected in the records of a comprehensive medical care program administered by their union-management welfare fund. The majority of these male workers are engaged in basic cargo handling, which often involves heavy and dangerous manual labor. Aside from the possibil-

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ity of accidents associated with this type of work, there may be occupationally related illnesses. The handling of grain and other dusty cargos may give rise to respiratory ailments. The nature of the physical labor and places of work also may be associated with such conditions as arthritis and bursitis.

Source of Data

Since July 1, 1955, a service contract has been in effect between the San Joaquin Foundation for Medical Care and the International Longshoremen's and Warehousemen's Union-Pacific Maritime Association (ILWU-PMA) Welfare Fund. This contract for health care of longshoremen and their dependents covers most or all of the cost of medical and surgical services. Its principal features have been summarized in reports by Harrington in 1959 (3) and by Krantz and Powell in 1961 (4). Under this service plan, union members who qualify for the eligibility list may receive medical care from any physician who is a member of the foundation. The latest available figures show that 99 percent of the active members of the San Joaquin County Medical Society are members of the foundation. Thus, services by virtually all physicians within the geographic area where union members live are available without direct charge.

Diagnostic data presented here were derived from a special study by the Division of Occupational Health, Public Health Service, of billing forms submitted to the foundation by participating physicians. These forms include diagnostic information along with dates of visits, whether office, hospital, or home, and types of procedures performed. All diagnoses recorded on these forms were coded in accordance with the sixth revision of the International Statistical Classification of Diseases, Injuries, and Causes of Death. The population of eligibles was obtained from records maintained by the Pacific Maritime Association, supplemented by records maintained by the ILWU-PMA Welfare Fund.

The measure of illness presented here follows the convention used by Densen and co-workers (2a) and will be referred to as the prevalence of disease or injury. It relates to active and retired workers qualified for the eligibility list

for a full 12 months during any of the 12-month periods beginning in July of 1955, 1956, 1957, or 1958. (Retired workers constituted less than 5 percent of the eligible workers.) The numbers of active and retired workers covered during each 12-month period are shown in table 1, for selected age groupings. A total of 2,064 man-years of experience is represented. Generally, the omission of persons covered only part of a year probably does not seriously bias the data presented except when a death occurred. For conditions such as heart disease and cancer, which are important causes of death, it is likely that prevalence is understated.

In processing data to obtain prevalence, any single disease or injury was counted only once during a year, even though several billing forms reflecting the presence of this condition may have been submitted to the foundation. The 122 categories of illness described in the report by Densen and associates (2b) were used in identifying illness categories.

Determination of any unusual prevalence of disease among longshoremen is necessarily dependent upon establishing an expected prevalence based upon data similarly derived for working populations with a heterogeneous oc-

Table 1. Number of longshoremen covered by medical care plan,¹ for 12 months,² Stockton, Calif., July 1955-June 1959, by year and by age

Age	Total man-years	Number longshoremen covered			
		1955-56	1956-57	1957-58	1958-59
All ages	2, 064	492	535	523	514
Under 20	8	5	3	0	0
20-24	86	22	24	20	20
25-29	165	47	43	39	36
30-34	206	43	46	58	59
35-39	240	55	67	63	55
40-44	319	91	80	77	71
45-49	341	78	92	84	87
50-54	302	68	75	80	79
55-59	159	34	40	37	48
60-64	137	30	39	39	29
65 and over	84	16	19	23	26
Unknown	17	3	7	3	4

¹ Contract between San Joaquin Foundation for Medical Care and Welfare Fund of the International Longshoremen's and Warehousemen's Union-Pacific Maritime Association.

² July-June.

cupational environment. Ideally, this expected prevalence should be based upon a large working population provided benefits by the San Joaquin Medical Care Foundation equal to those provided longshoremen. Unfortunately, records on such a group were not available. The expected prevalence of illness was therefore derived from data reported by Densen and co-workers for male enrollees in HIP. This report shows age-cause specific illness rates and represents 24,074 person-years of experience for males 15 years of age and over (20). It is the only published report with sufficient detail to permit the derivation of an expected prevalence of illness. Moreover, the data meet many of the criteria for evaluating morbidity among longshoremen. Enrollment under HIP is large and heterogeneous, and illness observed probably represents a fair cross section of illness observable through comprehensive medical care plans in large urban communities. Coverage for physician services under HIP is very similar to coverage under the ILWU-PMA contract with the foundation. Both plans exclude treatment for work injuries or conditions covered by workmen's compensation, alcoholism, drug addiction, nervous and mental disorders, and certain contagious diseases. Neither plan provides dental care, medicine, drugs, dressings, corrective appliances, or glasses.

There are administrative differences between the two plans. Under HIP, participating physicians receive payment on a per capita basis, whereas payment by the San Joaquin Foundation for Medical Care is on a fee-for-service basis. Under HIP, medical services are provided on a group practice basis, while under the foundation plan physicians practice singly if they so choose. It is not known to what extent these features bias the comparisons presented here.

Results

Table 2 shows the annual average prevalence of selected categories of disease seen among longshoremen by physician members of the San Joaquin Foundation for Medical Care. Diseases of the respiratory system were by a considerable margin the most important, accounting for about 20 percent of the illnesses and injuries reported. Diseases of the digestive

system and diseases of the circulatory system together accounted for nearly another 20 percent of the diagnoses.

In some respects the observed prevalence of disease shown in table 2 corresponded fairly closely to the expected prevalence. Of particular interest is the similarity between the observed and the expected prevalence of diseases of the circulatory system and neoplasms. Despite these similarities, the distribution of the observed prevalence of disease differs significantly, in a statistical sense, from the expected distribution (chi-square test: $P < 0.01$). Moreover, there are a number of specific diseases and injuries for which statistically significant differences exist, and it must be concluded that in some respects the observed prevalence truly differs from the expected prevalence. Diseases and injuries for which there is a statistically significant difference between the observed and the expected number of cases ($P < 0.01$) are shown in the accompanying list.

There is evidence in table 2 and in the list that some of the contrasts between observed and expected prevalence rates are due to differences between HIP physicians and Medical Care Foundation physicians in diagnostic standards and nomenclature. This is suggested by the low prevalence of gastroenteritis among longshoremen and the high prevalence of ulcer of the stomach and duodenum; the low prevalence of acute upper respiratory infection and of influenza and grippe in contrast to the high prevalence of other respiratory infections; and the low prevalence of strains and sprains in contrast to the high prevalence of other disorders of the bones and organs of movement. On the other hand, the high prevalence of diseases of the liver and pancreas and of the bladder and urethra and the high prevalence of nonoccupational lacerations and open wounds among longshoremen could represent a real contrast and could be peculiar to this group. While this finding may be related to the occupational environment, it seems likely that nonoccupational social and cultural factors are involved.

Discussion

The attempt here to identify occupationally related illness by comparing disease prevalence data for a single occupational group with an

Table 2. Observed and expected prevalence of selected diagnoses among longshoremen, Stockton, Calif.

Diagnostic category ¹	Number of cases		Diagnostic category ¹	Number of cases	
	Observed	Expected ²		Observed	Expected ²
Infective and parasitic diseases (001-021, 027-074, 080, 082-096, 100-130, 132-139)-----	44	33	Diseases of the digestive system— Continued		
Neoplasms:			Hernia (560-561)-----	24	28
Malignant (140-205)-----	9	10	Gastroenteritis (571)-----	22	40
Benign and unspecified (210-239)-----	30	32	Ulcerative colitis and chronic enteritis (572)-----	13	4
Allergic, metabolic, endocrine, and nutritional:			Gastritis; other diseases of stomach and intestines (543-545, 570, 573, 576-578)-----	70	87
Bronchial asthma (241)-----	13	19	Anal or rectal fissure, fistula, or abscess (574-575)-----	1	11
Other allergies (240, 242-245)-----	82	63	Diseases of liver and pancreas (580-583, 587)-----	22	3
Diabetes (260)-----	14	17	Diseases of gall bladder (584-586)-----	20	13
Obesity (287)-----	45	33	Diseases of genitourinary system:		
Other (250-254, 270-277, 280-286, 288-289)-----	43	20	Nephritis, nephrosis, kidney infection (590-594, 600-604)-----	24	15
Diseases of blood and blood-forming organs (290-299)-----	22	11	Diseases of bladder and urethra (605-609)-----	37	15
Mental, psychoneurotic, and personality disorders (300-318, 320-326)-----	52	83	Diseases of prostate and other male genital organs (610-617)-----	49	58
Diseases of nervous system and sense organs:			Diseases of the breast (620-621)-----	0	1
Vascular lesions affecting central nervous system (330-334)-----	3	4	Diseases of skin and cellular tissue:		
Neuritis, neuralgia (360-369)-----	54	38	Infections of skin and subcutaneous tissue (690-695, 698)-----	43	61
Diseases of the eye (370-379, 381-389)-----	51	100	Warts (696)-----	14	17
Diseases of the ear (390-398)-----	73	99	Dermatophytosis (131)-----	18	29
Otitis media (391)-----	32	31	Dermatitis and eczema (700-704)-----	38	54
Other (024-026, 340-345, 350-353, 355-357)-----	8	4	Other (697, 705-716)-----	69	92
Diseases of circulatory system:			Diseases of bones and organs of movement:		
All diseases of heart except congenital—			Arthritis (720-725)-----	67	53
Rheumatic fever and rheumatic heart disease (400-402, 410-416)-----	4	6	Rheumatism (726, 727)-----	20	83
Arteriosclerotic heart disease (420-422, 451)-----	58	40	Disorders of back (735-736, N846-N847)-----	50	55
Hypertensive heart disease (440-443)-----	4	6	Other (730-734, 737-738, 081, 740-749)-----	106	79
Other heart disease (022-023, 430-434)-----	13	8	Congenital malformations and certain diseases of early infancy (750-766)-----	15	6
Hypertension (444-447)-----	40	47	Symptoms and ill-defined diseases (780-792, 794-795, 354)-----	169	125
Varicose veins (460, 462)-----	13	15	Accidental injuries:		
Hemorrhoids (461)-----	41	48	Fractures and dislocations (N800-N839)-----	30	22
Other (450, 452-456, 463-468)-----	40	29	Sprains and strains, except back (N840-N845, N848)-----	20	46
Diseases of the respiratory system:			Head injuries (N850-N856)-----	1	7
Acute upper respiratory infection (470-475)-----	182	343	Lacerations and open wounds (N870-N908)-----	84	29
Influenza, grippe (481-483)-----	59	140	Contusions and superficial injuries (N910-N929)-----	29	43
Hypertrophy of tonsils and adenoids (510)-----	31	7	Foreign body in eye (N930)-----	9	15
Other (480, 490-493, 500-502, 511-527)-----	228	182	Burns (N940-N949)-----	6	7
Diseases of the digestive system:			Other specified injuries (N860-N869, N931-936, N950-N995)-----	10	7
Disease of buccal cavity and esophagus (530-539)-----	19	21	Injuries not otherwise specified (N996)-----	2	7
Ulcer of stomach or duodenum (540-542)-----	63	39			
Appendicitis (550-553)-----	6	5			

¹ Figures in parentheses refer to International List numbers (sixth revision).

² Based on 4-year age-specific prevalence rates observed among male enrollees in the Health Insurance Plan of Greater New York.

Diagnoses¹ among longshoremen which differed significantly² from expected prevalence, Stockton, Calif.

Prevalence lower than expected

Mental, psychoneurotic, and personality disorders (300-318, 320-326)
Diseases of the eye (370-379, 381-389)
Diseases of the ear (390-398)
Acute upper respiratory infection (470-475)
Influenza and gripe (481-483, 097-099)
Gastroenteritis (571)
Dermatophytosis (131)
Other diseases of skin and cellular tissue (697, 705-716)
Rheumatism (726, 727)
Sprains and strains, except back (N840-N845, N848)
Dermatitis and eczema (700-704)

Prevalence higher than expected

Other allergic, metabolic, endocrine, and nutritional diseases (250-254, 270-277, 280-286, 288-289)
Hypertrophy of tonsils and adenoids (510)
Other diseases of the respiratory system (480, 490-493, 500-502, 511-527)
Ulcer of stomach or duodenum (540-542)
Diseases of liver and pancreas (580-583, 587)
Diseases of bladder and urethra (605-609)
Other diseases of bones and organs of movement³ (730-734, 737-738, 081, 740-749)
Symptoms and ill-defined diseases (780-792, 794-795, 354)
Lacerations and open wounds (N870-N908)

¹ From sixth revision of International List.

² $P < 0.01$.

³ Two-thirds synovitis, bursitis, and tenosynovitis; one-third infective myositis and other inflammatory diseases of tendons and fascia.

expected prevalence reveals some problems in utilizing medical care data for epidemiologic studies. The comparison supports the notion that differences in diagnostic criteria and nomenclature exist among groups of practicing physicians, and this limits the usefulness of medical care data. Moreover, estimating occupational disease hazards will require considerable judgment to distinguish between disease related to the work environment and disease related to other environmental factors. None of the suggested occupational hazards associated with the work of longshoremen, that is, respiratory disease and arthritis and bursitis, could be detected through this analysis. No doubt considerable refinement in medical care plan statistics will be needed if new occupational hazards are to be identified.

This is not to imply, however, that careful study of medical records arising from medical care plans is unproductive. The detection of possible differences in nomenclature and diagnostic standards is in itself important, as are associations between disease and sociocultural factors, whether in or out of the work environment. Moreover, from an administrative standpoint, there are many advantages to be derived from such studies. Illness-prone individuals and populations which are high users of medical care can be identified and possibly corrective measures can be taken, and benefits can be adjusted on the basis of experience to provide the most satisfactory coverage for the medical consumer. Finally, there is undoubtedly a considerable potential for epidemiologic studies in these records, particularly where comparisons are made within a single plan and such factors as diagnostic standards and nomenclature can be brought under control.

Summary

New sources of information are needed to detect the specific effects of the occupational environment on the health of the employed population.

Records of a comprehensive medical care program for longshoremen were studied to see if any illnesses could be identified which were peculiar to this group of workers and possibly related to their work environment. The prevalence of diseases or injuries in this group was quite similar to expected prevalences estimated on the basis of experience in a larger comprehensive medical care program covering a variety of occupational groups. Statistically significant differences appeared to be due to variations in diagnostic nomenclature and standards or to nonoccupational factors.

It was concluded that considerable refinement in medical care statistics is needed before they will lead to the identification of new occupational disease hazards.

REFERENCES

- (1) Weissman, A.: Morbidity study of the Permanente Health Plan population. *Permanente Foundation Med. Bull.* 10: 12-26, August 1952.

- (2) Densen, P. M., Balamuth, E., and Deardorff, N. R.: Medical care plans as a source of morbidity data. *Milbank Mem. Fund Quart.* 38: 48-101; (a) 88-90, (b) 54-57, (c) 91-101, January 1960.
- (3) Harrington, D. C.: Foundation for medical care. *J.A.M.A.* 170: 969-972, June 20, 1959.
- (4) Krantz, G.: San Joaquin Foundation for Medical Care. *Am. J. Pub. Health* 51: 23-27, January 1961. Powell, J. R.: Discussion. 51: 27-30.

15th International Congress of Limnology

Aquaculture and water use, supply, pollution, and control were discussed at the 15th International Congress of Limnology, held at the University of Wisconsin, August 20-25, 1962, the first time in the United States.

Dr. Hans Liebman, Bavarian Biology Station, Berlin, reported a new method, developed in Munich, that can be used to measure the activity of sludges under streams. Discussants raised the possibility of applying the method to exact measurement of toxicity of industrial wastes.

J. S. Marshall, University of Michigan, asserted that the chemical composition of inland waters influences the fate of radioactive pollutants. He found that concentrations of radioactive strontium in plankton are influenced by dissolved salts, notably calcium, in lake water. He showed that it is possible to predict the degree of concentration of radioactive strontium in zooplankton if the concentration of dissolved calcium is known.

Dr. George P. Fitzgerald and Dr. Gerard A. Rohlich of the University of Wisconsin cultivated algal growths in ponded sewage and in the laboratory in order to study the biological removal of nutrients from treated sewage. Their studies indicated that under controlled laboratory conditions the rate of nutrient utilization and growth of the green alga, *Chlorella*, in primary or secondary effluent appears to be independent of the organic matter present. In addition to absorbing the major nutrients from the sewages, they pointed out that the algae will use up the carbon dioxide in the water and the resulting higher pH values will cause additional losses in the soluble phosphorus compounds present. They commented that it will be extremely difficult to select the type of algae which grow in sta-

bilization ponds. Engineers would like to limit algal species to long, filamentous types which are easily removed. However, algal growth is sensitive to environmental conditions, and desired kinds cannot simply be "planted."

By spreading stack dust from a cement plant in several lakes, ponds, and a trout stream, Dr. F. J. Trembley and Dr. B. W. Parker of Lehigh University reduced the acidity of the water and raised the mineral content, which increased plankton production, with the prospect of a general increase in fish. The stack dust consisted of 35 percent free alkali and other constituents of limestone.

An interim report of a 7-year study of the Great Lakes and Illinois River basins was presented by James L. Verber, oceanographer with the Department of Health, Education, and Welfare regional office in Chicago. Sixty stations in Lake Michigan, No. 1 on the study list, have automatic current meters and thermal recorders. Measurements of wind velocities, air and water temperatures, and allied phenomena are continuous. Recorders work at depths of 5, 30, 50, and 100 feet, and every 100 feet in deeper water. These operate untended for 4 months.

Detailed inshore studies of selected areas are carried on simultaneously. Studies of chemical, bacteriological, biological, and radiological factors are made in the lake at the same time the currents are under surveillance. The project was undertaken by the Public Health Service's Division of Water Supply and Pollution Control in September 1960, to plan a long-range program for controlling the quality of the Great Lakes region's water resources.